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Synthesis of cordierite geopolymer composite for high temperature applications

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Abstract

This work is part of a research project aiming at producing ceramic-like materials of high thermomechanical properties up to a temperature of 1000 °C, without the need for an initial sintering. Cordierite – metakaolin-based geopolymer composites have been synthesized. The alkalinization has been made by mixing the metakaolin with a potassium silicate solution. Two sources of metakaolin are used to observe the influence of the amorphous content and the presence of quartz. The consolidation has been made at a temperature below 100 °C. The cordierite powder comes from the recycling of automotive industrial waste. The microstructure and properties of the composite are characterized after the geopolymerization reaction and after heat treatment at 1000 °C. After geopolymerization, the geopolymer is in an amorphous state. After the heat treatment, the geopolymer crystallize in leucite. Furthermore, a significant part of the potassium seems to diffuse in the structure of the cordierite, leading to the stabilization of the indialite, the hexagonal structure of the cordierite at high temperature. The material exhibits a coefficient of thermal expansion of 2.5 10^{-6} K^{-1}. With a porosity of 35% and an elastic modulus of 16.7 GPa, this composite could be interesting to produce substrate for catalytic applications or filters.